subject for the first time, but to the attention of practised workers, who will find both interest and advantage from being brought into contact with those elemental principles and difficulties, which are apt to be lost sight of as they advance along their special lines of research.

PURE MATHEMATICS.

(1) *Plane Geometry.* By Prof. W. B. Ford and C. Ammerman. Edited by E. R. Hedrick. Pp. ix+213+xxxi. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 3*s.* 6*d.* net.

(2) *Higher Algebra.* By Dr. W. P. Milne. Pp. xii+586. (London: Edward Arnold, 1913.) Price 7*s.* 6*d.* net.

(3) *The Twisted Cubic: with Some Account of the Metrical Properties of the Cubical Hyperbola.* By P. W. Wood. Pp. x+78. (Cambridge: University Press, 1913.) Price 2*s.* 6*d.* net.

(4) *Graphical Methods.* By Prof. Carl Runge. Pp. viii+148. (London: Oxford University Press; New York: Columbia University Press, 1912.) Price 6*s.* 6*d.* net.

(5) *Einführung in die Mathematik für Biologen und Chemiker.* By Prof. L. Michaelis. Pp. vii+253. (Berlin: Julius Springer, 1912.) Price 7.80 marks.

(6) *Théorie des Nombres.* By E. Cahen. Tome Premier. Le Premier Degré. Pp. xii+408. (Paris: A. Hermann et Fils, 1914.)

(1) THIS text-book, written by two American professors, is arranged on lines similar to those of modern English text-books. Fewer theorems, more experimental geometry, and numerous practical applications are its chief characteristics. In placing properties of areas after those of circles and similar figures, the authors have adopted a change of order, which we believe will eventually become general. The idea of similarity is so fundamental and at the same time presents comparatively so little difficulty, that it is in our view regrettable that in many examination syllabuses, and consequently in most school courses, it should be postponed to a late period. In fact, it is probably true to say that many boys leave school without any knowledge of what is one of the most valuable, practical, and important branches of geometry.

(2) There are in this volume distinct merits and a certain originality of treatment such as will appeal to many teachers of the modern school. No attempt has been made to develop the subject in a rigorous and logical fashion from the fundamental axioms of number, and we agree with Dr. Milne's opinion that students at this period of their training are ill-fitted for what is almost a philosophical discussion. But at the same time it is becoming generally recognised that the harm done by inculcating incorrect notions of limits, convergence, etc., is so serious and so difficult to remedy that many teachers have, with little assistance from current text-books, been taking their scholarship candidates through a course of serious analysis. They will undoubtedly welcome the publication of this treatise, which with admirable clearness and with an abundance of detailed explanations and illustrations, sets out the lines upon which accurate investigations of the existence of limits and the convergence of single and double series must proceed. More than half the book is occupied with work of this character.

The scope of treatment is best indicated by an enumeration of the headings of the chapters:—Rational numbers; irrational numbers; summation; binomial theorem; permutations and combinations; exponential and logarithmic series; continued fractions; theory of equations; determinants; miscellaneous theorems. In his selection and arrangement of material, the author has, therefore, departed considerably from the customary plan. What little "Theory of Numbers" there is, comes in the first chapter; the usual account of probability has been considerably curtailed; diophantine problems and inequalities receive very brief treatment; and the chapter on permutations follows, instead of precedes, the binomial theorem. There is a good collection of examples at the end of each chapter; we regard, however, as unfortunate the omission of any intermediate sets. Clearly it is undesirable for a student to read the whole of a chapter before doing any examples, and the result of grouping them at the end is to saddle the teacher with the burden of selection.

The final collection of four hundred miscellaneous problems and a number of questions of an essay type call for special notice. Teachers and pupils alike will probably feel the need of an index. Dr. Milne has produced an essentially scholarly work, and we have no hesitation in classing it with those books which are exercising a wholesome and valuable influence on mathematical teaching.

(3) It is curious that no systematic account should have been hitherto published of the properties of the space curve of the third order, although many mathematicians have given their attention to the subject, the fruit of which is to be found in a number of isolated memoirs and, incidentally, in a few treatises, as, for example.

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in Grace and Young's "Algebra of Invariants," where the invariants and covariants of a binary cubic are interpreted in terms of the geometry of the skew cubic. This is now remedied by Mr. Wood's tract, which discusses the subject *ab initio*. The first section deals with the projective properties of the curve, developed analytically with the use of homogeneous coordinates, and the second is specially concerned with the cubical hyperbola (the case in which the curve has three real and distinct points at infinity), and discusses the properties of asymptotes, diameters, vertices, centre, axis, inscribed and circumscribing quadrics, the rectangular cubical hyperbola, etc. No one who is interested in geometry can fail to appreciate the collection of properties which Mr. Wood has made, and many will, no doubt, be encouraged by the way in which the initial stages have been simplified, to pursue the subject beyond the limits which space has here rendered necessary.

(4) The purpose of this book is to supply the theoretical basis upon which graphical methods rest, and to discuss in general terms the manner in which applications may be made to shorten the labour involved in the heavy computation with which the physicist and engineer are so often faced. In many cases special graphical methods have been invented to cope with a particular kind of problem, and in view of the fact that there is little inter-communication between those working in different spheres, the opportunity of making use in one department of a device that has been of value in another is often missed, on account of the failure to recognise the generality of the principle which has been employed. The subject-matter is divided into three sections: the first deals with graphical arithmetic, the evaluation of integral functions, and the treatment of complex quantities; the second with the representation of functions of one or more variables, the principle of the slide rule, and the idea of conformal representation; and the last with the calculus and the solution of differential equations.

(5) This course of pure mathematics is most distinctly a lower limit of the equipment every scientific student should possess. The ideas of the calculus are at last beginning to find their way into the ordinary curriculum, more rapidly on the Continent than in England, and the time cannot be far distant when it will be impossible for boys who specialise in chemistry or physics to leave school ignorant of infinitesimal methods. The book deals with revision of arithmetic, algebra, geometry, and trigonometry; graphs of functions; differential and integral calculus, with special reference to expansion in series; and differential equations. The sections of the calculus make rather dull reading, little indication being given of the nature of the applications that it permits. The systematic treatment of what may be called the grammar of the subject should, however, enable the reader to acquire some degree of facility in performing ordinary operations.

(6) What is the criterion that distinguishes the theory of numbers from other branches of analysis? To this question, M. Cahen makes the following reply:—"The Theory of Numbers is a science in which division is *possible* only in special cases, whereas elsewhere division is *impossible* only in special cases." And this statement gives in brief the limits he has set himself in this treatise. The first eight chapters deal with addition, multiplication, subtraction, and divisions of integers, H.C.F. and L.C.M., and fractions; the next four with systems of diophantine equations of the first degree; then follow chapters on linear substitution and groups, linear and bilinear forms, congruences, matrices, prime numbers.

The treatment is thorough in character, and the work is set out so clearly that no student, however small his previous knowledge may be of the theory of arithmetic, should find it difficult to follow the argument; and if he reads through this volume carefully and tests his progress by working out some of the examples provided, he should obtain a firm grasp of this important modern subject. Text-books such as these form an admirable preparation for the student who wishes to make a more specialised study of the subject, for, by giving him a sound groundwork, they make it possible for him to consult intelligently the original memoirs which mark the growth of the theory, and which no text-book, however comprehensive, can in reality replace.

OUR BOOKSHELF.

Dental Diseases in Relation to Public Health. By Dr. J. Sim Wallace. Pp. viii+90. (London: Office of *The Dental Record,* 1914.) Price 3s. net.

THIS book consists of three chapters. They are addresses given by the author in "response to requests." Chap. i. sets forth in detail the prevalence of dental diseases, the serious effects they exercise on general health—especially during childhood—and the methods by which such diseases may be prevented. There are, however, within its pages statements based on loose figures, which are calculated to mar the effect the writer has in view by causing an impression of exaggeration of unverified inference. On the strength of the statement—itself too wide a generalisation—that 75 per cent. of the total population have irregularities of the teeth, we have presented to us the wild statement that "the number of teeth

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